Fig. 12. Front view of the head of *Cicada* sp. *pl*, plates with which the maxillæ articulate.
Fig. 13. Transverse section through the proboscis of *Sarcopsylla penetrans*, middle.
Fig. 14. Transverse section through the rostrum of *Notonecta glauca*, apex.
Fig. 15. Transverse section through the proboscis of *Pulex irritans*, base.

VI.—*New Investigations on the Development of the Viviparous Aphides.* By Dr. Otto Zacharias *.

Since the appearance of Metschnikoff's 'Embryologische Studien an Insecten' (1866) the development of the embryo of the viviparous Aphides has not again been made the subject of a monographic investigation. What the Russian author established with regard to the mode of development of the "pseudova" of *Aphis Rosæ* and *A. Pelargonii* passes pretty generally for all that is observable at present. Metschnikoff's description of the development of Aphides (at least in its fundamental features) is regarded as a "rocher de bronze," which presents no point of attack for an incisive criticism. This, however, is not the case, and I will, in a memoir that will appear very shortly, furnish the proof that Metschnikoff's description of the *first* developmental stages (as far as the formation of the S-shaped germinal streak, and even somewhat later) by no means agrees with the facts. For the subsequent stages I have also obtained quite different results of investigation, which I shall venture to summarize at the conclusion of this preliminary note.

The observation of the embryonic development of the viviparous Aphides is for many reasons a difficult matter. Besides the minuteness and delicacy of the objects with which we have to do, there is a third condition which causes many obstacles to the investigation, namely the clearness and strong refractive power of the protoplasmic contents of the egg. If in the case of the eggs of many other insects we have to contend with the obscurity of their yelk, it is in the Aphides the crystal clearness of the latter which frequently acts very prejudicially: prejudicially, inasmuch as under the circumstances indicated the upper half of the egg constantly acts upon the lower half (or *vice versâ*), like a lens with a very short focus, and not only enlarges but also distorts those

* Translated from the 'Zoologischer Anzeiger,' no. 168, May 26, 1884, pp. 292–296.

parts of the embryo which lie in a plane passing through the middle of the egg parallel to the object-slide. This opens up a rich source of illusions for those who come uncritically to the investigation; but for those who are aware of the optical behaviour of the pseudovitellus there arises the unconditional necessity of correcting every surface-picture observed by the side view corresponding to it, and, if possible, by the other surface-picture (that directly opposite to the first). In the former case the embryo must be turned 90°, in the latter 180°.

Without this method of rolling, already mentioned by Harting in his well-known work on the microscope, it is not possible to make out the earliest development of the *Aphis*-embryo. Of course it is not easy to practise the method referred to, and many a fine preparation is sacrificed by clumsy handling of the wire which is employed in producing the rotation. In my memoir I will describe in detail the rolling method as it should be constantly employed in the more delicate investigations in insect embryology.

I will now briefly indicate in what principal points the results of my investigations differ from those obtained by the distinguished Russian naturalist.

The pseudovum possesses no chorion, but only a vitelline membrane, Huxley's "pseudo-vitelline membrane." This encloses the whole contents of the egg, which, at a certain early period (as Leuckart first remarked *), shows a distinction between peripheral and central cells. We read also in Huxley as follows:—"They [the pseudova] exhibit a central darkish matter surrounded by a clear cortex." Upon this point the simplest observation gives clear information. The development of the embryo now starts from the "clear cortex," the *blastoderm*, which forms a multilamellar vesicle, and, indeed, in this way, that at its lower pole (*i. e.* that turned towards the vagina) a thickening is formed, from which the germinal streak grows forth *laterally* (and near to the inner wall of the blastoderm) in the form of a small thick tongue. The yelk at this time contracts strongly, and places itself, as a rounded mass, also at the inferior pole of the germinal vesicle. This is the profile view, so to speak. If we now roll the pseudovum through 90° we obtain a view *en face*; and Metschnikoff appears to have this alone in his eye when he speaks of a germinal and a vitelline "hill," the appearance of which characterizes the earliest embryonic stage of the viviparous Aphides. In the surface-view our glance of course falls first upon the broad side of the tongue, which now looks like a

* 'Zur Kenntniss des Generationswechsels und der Parthenogenese bei den Insekten' (1858), p. 20.

"hill," and behind it rises the contracted yelk, and also appears like a hill. This therefore explains how Metschnikoff came to the notion of a germinal and vitelline hill. But such a notion is not justified by the facts, and still less that of a special *genital* hill from which the reproductive organs are to originate. It is moreover quite incomprehensible that so practised an observer as Metschnikoff even then was could overlook the fact that the tongue of the germinal streak growing freely into the cavity of the blastoderm immediately shows a deep groove in its median line, becomes rounded off on both sides throughout its whole length, and thus produces two distinctly marked *germinal pads*. Metschnikoff, on the contrary, repeatedly remarks that the embryo in its early stage shows *no trace* of such pads *.

This negative judgment I can only explain by the fact that Metschnikoff apparently does not practise the "method of rolling," and therefore did not get to see the different aspects of the embryo. In this opinion I am only strengthened by the examination of his figures 16, 17, 18, 19, and 20 (pls. xxviii. and xxix.), as also by the reading of the text relating to them (pp. 444–448). Every one who comes fresh and unprejudiced to the investigation of the development of the Aphides will make the surprising observation that the developmental processes which finally lead to the formation of the S-shaped germinal streak are not performed in the plane in which Metschnikoff places them in his figures, but in one standing directly perpendicular to it. In my memoir I shall produce the exact proof of this, and also furnish the requisite figures which I have found to be verified in hundreds of preparations.

As regards the S-shaped germinal streak, which is well known to all investigators of Aphides, the inferior curve of this letter (which is turned to the left) represents the *cephalic hood*, the same structure, it may be said in passing, which Huxley, entirely mistaking the relative position of the Aphis-germ, characterized as the "abdominal hood." The upper curve (turned to the right) represents the rudiment of the abdomen, and the intermediate part contains the material for the formation of the head and thorax.

The *limbs* take their origin from a special superficial layer, the so-called *limb-plate* ("Extremitätenplatte"), as to the origin of which Metschnikoff has not got at the truth either in *Simulia* and *Corixa* or in *Aphis Rosæ* (see his paper, *loc. cit.* pp. 400, 427, and 448). For the Aphides I have

* Zeitschr. f. wiss. Zool. Bd. xvi. (1866), pp. 448 and 450.

succeeded in proving that the so-called "Extremitätenschicht" is a part of the blastoderm which at a very early period enters into an intimate fusion with the true germinal streak. The details of this are treated of in my memoir.

Besides the two *vertex-plates* (Huxley's "procephalic lobes") which originate from the primitive lateral plates, we have also to distinguish in Aphis-embryos a *median plate*, which is produced from the ventral part of the cephalic hood. I would name it the *mandibular plate*, as the two mandibles are formed from it.

The first and second *maxillæ* originate from that part of the limb-plate which overlies the procephalic portion of the germinal streak, or is amalgamated with the latter. The arrangement of the three pairs of buccal organs is of such a kind that a hexagon is formed, the outer angles of which are constituted by the first maxillæ.

Later on the rudiments of the mandibles and first maxillæ are enclosed in the depth of the head, and from them originate the "*retort-shaped bodies*" (of Metschnikoff), which secrete the chitinous stylets of the rostrum. In the mature embryo we perceive two such bodies *on each side*, not one only, as Metschnikoff's figures show. *By the demonstration that it really is by the transformation of the mandibles and maxillæ that the retort-shaped bodies are produced, the parts of the mouth of the Aphides are first brought into homology with the corresponding organs in other insects.*

According to Metschnikoff, as is well known, the mandibles and first maxillæ are completely retrograded, and the "bodies" secreting the piercing setæ originate quite newly. This was *à priori* very improbable, and observation gives quite another result. By carefully crushing half-mature embryos the actual conditions may often be very beautifully brought into view.

Witlaczil, who has treated of the anatomy of the Aphides in much detail in a recent memoir *, gives a very full description of the structure of the retort-shaped bodies as studied by him by means of sagittal and transverse sections through fully-developed animals.

For orientation in many difficult points of the development of Aphides, *e. g.* as to the question whether or not the *Malpighian vessels* are present in these animals at any time, I have turned to the allied group of the Coccidæ, and not without success. Thus I distinctly saw in *Coccus hesperidum* that the *brown* masses of substance corresponding to the secondary vitellus in *Aphis Rosæ* arrange themselves very

* 'Zur Anatomie der Aphiden' (Wien, 1882).

early in the form of two long cords, which open close together into the intestine in the region of the rectal section. According to this observation I do not hesitate to adopt Witlaczil's view, according to which the green cell-mass in the abdomen of the viviparous Aphides (which is likewise arranged into two cords) represents the Malpighian vessels of other insects. In a very pale Aphis-embryo I was able clearly to detect, besides the very distinctly marked dorsal vessel, the point of convergence of the two cords, but without distinctly seeing the point of discharge (as in *Coccus hesperidum*).

The egg of the viviparous Aphides, for which I have here and there, for convenience' sake, employed the antiquated term "pseudovum," therefore presents exceedingly interesting and very distinctly observable developmental processes, which cannot be sufficiently studied. In recent times Dr. Arnold Brass* (of Leipzig) and Dr. Ludwig Will† (of Rostock) have occupied themselves with the earliest stages of development. The last-mentioned gentleman has also already announced the publication of a work upon the later stages of the Aphis-embryo. In course of time many other workers will certainly have to be registered for this highly interesting subject.

VII.—*Notes on the South-Russian* Spongillidæ.

By Dr. W. Dybowski ‡.

Dr. P. T. Stepanow, Professor of Zoology in the University of Charkow, has had the kindness to send me some specimens of the freshwater sponges for scientific investigation. The sponges preserved in the Museum of the above University and those collected by Prof. Stepanow himself are from the following localities :—

1. From the river Udy (a right affluent of the Siewiernyj Daniec), Gov. Charkow.
2. From Lake Lebiedin (Circle Lebiedin), Gov. Charkow.
3. From the river Kolomak (left affluent of the Worska, a branch of the Dnieper), Gov. Poltawa.

* "Das Ovarium und die ersten Entwicklungsstadien des Eies der viviparen Aphiden," in Zeitschr. f. Naturwiss. Bd. iv. (1882).

† "Zur Bildung des Eies und des Blastoderms bei den viviparen Aphiden," in Arbeiten des Zool. Instit. zu Würzburg, 1883, Heft 3.

‡ Translated by W. S. Dallas, F.L.S., from the 'Sitzungsberichte der Naturforscher-Gesellschaft bei der Universität Dorpat,' Bd. vi. pp. 507–515 (1884).